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Patent Application Sho 53-104210

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## SPECIFICATION

### 1. Title of the Invention

Liquid crystal display panel

### 2. Scope of Claim for Patent

- 5        1. In a liquid crystal display panel utilizing a semiconductor substrate provided with a plurality of active elements and passive elements, said liquid crystal panel characterized in that said semiconductor substrate is provided with electrode films in a matrix form corresponding to said active elements and said passive elements
- 10       over a surface of the semiconductor substrate, which surface has been planarized, and a surface of said semiconductor substrate is covered with an orientation treatment film.
- 15       2. The liquid crystal display panel of claim 1, wherein the planarized surface of the semiconductor substrate is formed by coating an insulating material in varnish form at a film thickness of 1 to  $5\mu$  on the semiconductor substrate having big irregularity.
- 20       3. The liquid crystal display panel of claim 1, wherein the orientation treatment film on the surface of the semiconductor substrate is an oblique evaporation film of SiO.
4. The liquid crystal display panel of claim 1, wherein the liquid crystal has a twisted nematic structure.
5. The liquid crystal display panel of claim 1, wherein the liquid crystal comprises polygenetic color and nematic liquid crystal.

### "Detailed Description of the Invention"

The present invention relates to a liquid crystal display panel. Further, the present invention relates to a surface configuration and a surface treatment of a semiconductor substrate which is utilized for one of substrates constituting a display cell.

Recently, the display device is extremely advanced. Especially, the display device using liquid crystal has many advantages of low voltage driving, low power, thin type and long life. In these days, it is utilized for various kinds of display devices such as wristwatch, pocket calculator. On the other hand, as a practical uses, the display device is applied for character display and television by making the best use of the above mentioned advantages of the liquid crystal display device. In this way, in case that the number of rows and columns of matrix display is big, it is effective to statically drive a liquid crystal utilizing active elements, which are prepared on a semiconductor substrate as one of the substrates constituting the display cell. The present invention relates to this static drive type liquid crystal display device.

Fig. 1 shows a conventional liquid crystal display panel. Fig. 1 shows a structural drawing of the conventional liquid crystal display panel. Reference numeral 1 in the figure shows a semiconductor substrate comprising active elements or passive elements. A liquid crystal driving electrode 2 is prepared on a surface of a semiconductor substrate in a form of matrix. Reference numeral 5 shows a spacer, and a transparent conductive film 4 is formed on an upper side glass plate 3. Reference numeral 6 shows a liquid crystal. Fig. 2 shows a cross sectional drawing of a semiconductor substrate. In Fig. 2, a region enclosed with two dot chain line equals to one pixel. One transistor and one condenser are included in one pixel. In the figure, reference numeral 7 shows, for example, a n-type silicon substrate, 8 shows a p-type diffused layer, 9 shows a n<sup>+</sup> type diffused layer, 10 shows a field oxide film, 11 shows an SiO<sub>2</sub> film, 12 shows a doped polysilicon film, and 13 shows a CVD SiO<sub>2</sub> film. 14 is an aluminum film comprising electrode and wiring. 15 is a protective film, which is usually a CVD SiO<sub>2</sub> film. In Fig. 2, the part A is a transistor and the part B is a condenser. As apparent from Fig. 2, in case that the semiconductor substrate is manufactured by a conventional process, a step of approximately 1 to 3  $\mu$  is formed on the surface of the semiconductor substrate. The unevenness of the surface is generally large although it depends slightly upon the configuration of the elements embedded in the semiconductor substrate and the manufacturing process. Therefore, as shown in Fig. 2, when an orientation treatment is

conducted on the surface of the semiconductor substrate having big irregularity by oblique evaporation of SiO or the like, there is formed one surface on which the SiO film is formed and another surface on which no SiO<sub>2</sub> film is formed as shown in Fig. 3. In Fig. 3, 16 is the semiconductor substrate having irregularity on the surface thereof. 17 is a direction of evaporation of SiO particles which are deposited by an oblique evaporation at an angle  $\theta = 70$  to  $89^\circ\text{C}$  and 18 is an SiO film formed on a semiconductor substrate. As apparent from the figure, the bigger the irregularity formed on the surface of the semiconductor substrate 16 is, the smaller the proportion of the surface having the SiO film formed thereon is. If a proportion of the surface having no SiO film is large, this part does not contribute to the actual display. Therefore, the contrast extremely reduces and the function as a display device deteriorates. The present invention removes the defect of the conventional liquid crystal display panel. Referring to the detail examples, the object of the present invention will be set forth in the description.

Usually, the surfaces of two substrates constituting the liquid crystal display panel needs to be treated with a horizontal orientation or vertical orientation treatment depending upon the display mode and the kind of the liquid crystal. There are many methods as an orientation treatment, for example, rubbing process, oblique evaporation, and dipping method using such as silane coupling agent. However, in view of characteristic and homogeneous quality, oblique evaporation process is best. In the oblique evaporation method, SiO or Teflon is evaporated on the substrate in vacuum at an angle of  $70$  to  $89^\circ$  and thin and long lines are innumably formed at intervals of several hundreds to several thousands Å(angstrom) on the surface of the substrate in order to conduct the orientation of the liquid crystal. In case of conducting oblique evaporation to glass substrate, an oblique evaporation film 20 is deposited on an entire surface because a surface of a glass plate 19 is flat as shown in Fig. 4. On the other hand, in case that a semiconductor substrate is used, a step of  $1.0\mu$  or more is formed on a surface as mentioned above. If a semiconductor substrate having a step of  $1.0\mu$  on the surface is subjected to an oblique evaporation at an angle of  $80^\circ$ , an oblique evaporation film is not deposited on a region of  $5.8\mu$  at one side of the step portion. The present invention has been made to solve the problem described above, thereby obtaining the display panel having high contrast and the excellent image quality. Concretely, in case that the surface of the semiconductor substrate which contributes to the display is flatten and conduct an oblique evaporation, it characterized that a ratio of portion having no oblique evaporation film is reduced. Fig. 5 shows a cross-section

al drawing of construction of a substrate having reduced a step on the surface of the semiconductor substrate. Reference numerals 7 to 14 in Fig. 5 corresponds to that in Fig. 2. Reference numeral 21 in Fig. 5 is a layer to flatten the surface of the semiconductor substrate, which is the point of the present invention. Further, as a liquid crystal driving electrode, a transparent conductive film layer or a metal layer 22 is formed on the layer 21. The liquid crystal driving electrode is connected with a lower wiring 14 by through hole. The layer 21 which flattens the surface of the semiconductor substrate may comprise polyimide resin, glass having low melting point, insulating material, or the like. In case that a polyimide resin is used, a polyimide film having a thickness of 1 to  $5\mu$  on the surface of the semiconductor substrate by polyimide varnish and spinner application. In this case, silane coupling agent is applied to a base semiconductor substrate to enhance the adherence between the base film and a polyimide film. Subsequently, it is cured at a temperature of 350 to 550°C. Through holes may be formed by photoetching by using hydrazine solution or NaOH. Then, a liquid crystal driving electrode may be formed. Polyimide is used as a flattening material for the semiconductor substrate because it is superior in heat resistance to other organic resins and it can be formed at a thickness of 10  $\mu$  without crack. Furthermore, polyimide is superior in passivation effect. However, the present invention is applied to not only a polyimide film but also a glass having low melting point, for example, a lead glass comprising  $PbO_2$  as a main component, a zinc glass comprising  $ZnO_2$  as a main component or a phosphorus glass comprising  $P_2O_5$  as a main component. If a step of 0.5  $\mu$  or less is formed on the surface of the semiconductor substrate after deposition, the above mentioned materials can be sufficient for the present invention. By an oblique evaporation, an orientation film is formed on a surface of the flattened semiconductor formed by the above mentioned process. Thereby, as shown in reference numeral 20 in Figs. 5 and 6, almost all display portions can be treated with an orientation process, so that the contrast of the liquid crystal display panel is remarkably improved and it is possible to obtain a good image of the display panel. In Fig. 6, reference numeral 23 is a semiconductor substrate having a planarized surface, and 24 is a liquid crystal driving electrode. By using the semiconductor substrate having the planarized surface according to the present invention, contrast of the liquid crystal display panel is improved to several times as compared with conventional one.

In the present invention, the substrate having a MOS type transistor is

explained as a semiconductor substrate, however, a substrate having TFTs or a SOS substrate may be used as the semiconductor substrate. Moreover, a semiconductor substrate may be consisting of not only active elements but also passive elements. When a liquid crystal display cell according to the present invention is applied to the liquid crystal display television, it is very effective to obtain a high contrast. In this case, a liquid crystal may be a twisted nematic type having low driving voltage or a nematic liquid crystal is mixed with dichroism color. If a semiconductor substrate having a flatten surface is used, display having an improved contrast can be obtained because the thickness of the liquid crystal can be uniform.

As above mentioned, the present invention relates to the liquid crystal display panel, which is characterized that a surface of the semiconductor substrate used for one side of the display panel is planarized to improve the contrast.

#### "Brief Explanation of The Drawings"

Fig. 1 illustrates a cross sectional structure of a liquid crystal cell.

Fig. 2 is a cross sectional view showing an irregularity, which is formed on the surface of a conventional semiconductor substrate.

Fig. 3 shows an orientation treatment of a substrate having a big irregularity.

Fig. 4 shows an orientation treatment of a glass having a planarized surface.

Fig. 5 shows a cross sectional view of a semiconductor substrate having a planarized surface in accordance with the present invention.

Fig. 6 shows an orientation treatment of a substrate having a planarized surface.

- |  |                                      |
|--|--------------------------------------|
| 1---semiconductor substrate                            | 2---liquid crystal driving electrode |
| 3---upper side glass plate                             | 4---transparent conductive film      |
| 5---spacer   | 6---liquid crystal                   |
| 7---n type silicon substrate                           | 8---p+ type diffused layer           |
| 9---n+ type diffused layer                             | 10---field oxide film                |
| 11---gate oxide film                                   | 12---doped polysilicon film          |
| 13---CVD SiO <sub>2</sub> film                         | 14---a second layer wiring           |
| 15---CVD SiO <sub>2</sub> film                         |                                      |
| 16---semiconductor substrate having a big irregularity |                                      |
| 17---oblique evaporation direction                     |                                      |
| 18---oblique evaporation film                          | 19---glass plate                     |

20---oblique evaporation film

21---a layer to make a surface of semiconductor to be planarized

22---liquid crystal driving electrode

23---semiconductor substrate having a planarized surface

5

24---liquid crystal driving electrode

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液晶表示パネル

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## 明 細 書

発明の名称 液晶表示パネル

発明の要旨

(1) 液晶セルを構成する一方の電極は、電極膜の断端部及び受動電極をマトリックス状に配列した半導体基板上に液晶表示パネルにおいて、液晶体層は表面平滑化処理が施された基板表面上に電極膜及び受動電極に形成してマトリックス状に電極膜が形成されておりかつ液晶体層表面は電極膜に平行して形成されていることを特徴とする液晶パネル。

(2) 半導体基板上の表面平滑化処理は、凹凸の多い半導体基板上に、1〜5μmの厚さでフッ素酸の10%溶液を塗布形成して成ることを特徴とする液晶表示パネル。

(3) 半導体基板上の表面平滑化処理は、凹凸の多い半導体基板上に、1〜5μmの厚さでフッ素酸の10%溶液を塗布形成して成ることを特徴とする液晶表示パネル。

液晶表示パネル。

(1) 液晶表示パネル内の液晶は、液晶マトリックス構造を有することを特徴とする液晶表示パネル。

(2) 液晶表示パネル内の液晶は、多結晶性液晶マトリックス構造を有することを特徴とする液晶表示パネル。

発明の詳細な説明

本発明は液晶表示パネルに関するものである。従って本発明は、液晶セルを構成する一方の電極に形成した半導体基板上の表面平滑化処理に関するものである。

従来、液晶表示パネルは、液晶セルを構成する一方の電極に形成した半導体基板上の表面平滑化処理は、凹凸の多い半導体基板上に、1〜5μmの厚さでフッ素酸の10%溶液を塗布形成して成ることを特徴とする液晶表示パネル。

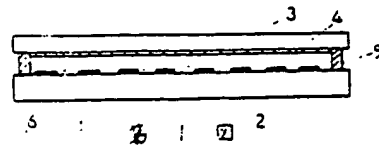


- 1 7 ... 磁気方向
- 1 8 ... 磁気膜
- 1 9 ... ガラス板
- 2 0 ... 磁気膜
- 2 1 ... 半導体膜を平坦化する層
- 2 2 ... 磁気膜の電極
- 2 3 ... 磁気膜を平坦化した半導体膜
- 2 4 ... 磁気膜の電極

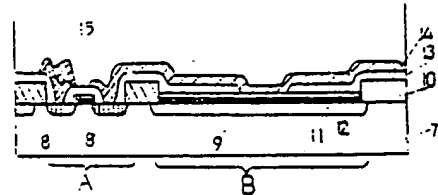
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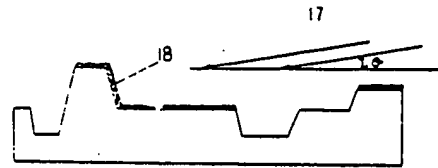
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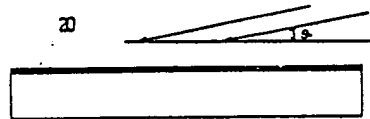
第 1 図



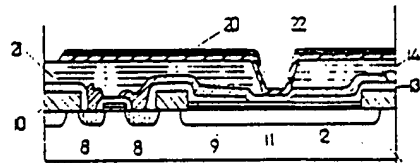
第 2 図



第 3 図



第 4 図



第 5 図

